



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE

United States Patent and Trademark Office

Address: COMMISSIONER FOR PATENTS

P.O. Box 1450

Alexandria, Virginia 22313-1450

www.uspto.gov

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|--|-------------|----------------------|---------------------|------------------|
| 10/561,294 | 12/20/2005 | Rachel Leach | 423108 | 8023 |
| 30955 7590 05/07/2008 LATHROP & GAGE LC 4845 PEARL EAST CIRCLE SUITE 300 BOULDER, CO 80301 | | | | |
| EXAMINER | | | | |
| WONGWIEN, PHUTTHIWAT | | | | |
| ART UNIT | | PAPER NUMBER | | |
| 4177 | | | | |
| MAIL DATE | | DELIVERY MODE | | |
| 05/07/2008 | | PAPER | | |

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary

Application No.

10/561,294

Applicant(s)

LEACH ET AL.

Examiner

PHUTTHIWAT WONGWAN

Art Unit

4177

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 12/20/2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-29 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-29 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 20 December 2005 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-8508)
- Paper No(s)/Mail Date 12/20/2005
- 4) ☐ Interview Summary (PTO-413)
- Paper No(s)/Mail Date _____
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: _____

DETAILED ACTION

Drawings

1. Figure 1 should be designated by a legend such as --Prior Art-- because only that which is old is illustrated. See MPEP § 608.02(g). Corrected drawings in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. The replacement sheet(s) should be labeled "Replacement Sheet" in the page header (as per 37 CFR 1.84(c)) so as not to obstruct any portion of the drawing figures. If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claim 1-29 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

4. As to claims 1, 15, 23 and 29, the limitation "having self-regenerative surface morphology" is unclear, although the applicant discloses in the specification that "propellant exhibits rapid self-regenerative surface morphology; it is stored in solid form, and is then heated so that its surface converts to a semi-molten state so that its surface tension naturally and continually reforms with a new smooth target surface layer" (page 14, paragraph 5-15). However, it is still unclear whether the propellant has a self-regenerative property as it heated or a new surface is formed as the laser ablates and heats the surface which causes the propellant to

evaporate, therefore, a new smooth surface is formed. As best understood by examiner, a new surface is formed as the laser ablates and heats the surface which causes the propellant to evaporate, therefore, a new smooth surface is formed.

5. As to claim 7, the limitation “measures capacitance of the capillary ducts to determine the amount” is unclear (of what?) amount is being determined.
6. As to claim 19, the limitation “interlocking” is not described in the specification, as best understood by examiner; interlocking means attach or mount together.
7. As to claim 20, the limitation “plug-and-play” is not described clearly in the specification.
8. As to claim 27, the limitation “LSCD” is not described in the specification.
9. As to claims 2-6, 8-14, 16-17 and 19, 21-22, 24-26 and 28, the claims are rejected because they depend on rejected claims 1, 15 and 23.

Claim Rejections - 35 USC § 102

10. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –
(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

11. Claims 1-5, 8 and 23 are rejected under 35 U.S.C. 102(b) as being anticipated by Hoskins (US Patent No. 6,373,023).
12. As to claim 1, as best understood, Hoskins discloses a hybrid electric-laser propulsion thruster comprising: a propellant 30, (fig. 1, as best understood by the examiner, it is well known that as the laser ablates into the propellant's surface to generate exhaust plasma, the propellant turns into semi-molten state before it evaporates, as the laser bored into the surface of the

propellant, bored surface is replaced by the propellant in semi-molten state, therefore, the propellant is inherently having self-regenerative surface morphology) having self-regenerative surface morphology, a laser 704 (fig. 7) for ablating the propellant to create an ionized exhaust plasma (col. 7, line 64-67) that is non-interfering with a trajectory path of expelled ions and an electromagnetic field generator 722A, 722B (fig. 7) for generating an electromagnetic field that defines a thrust vector for the exhaust plasma (col. 7, line 60-67).

13. As to claims 2-4, Hoskins discloses that the thruster comprising a controller for implementing control algorithms for controlling the HELP thruster to meet commanded performance (col. 1, line 32-35), a baffle 31 (fig. 1) for protecting the laser from contaminants released when the propellant is ablated, capillary subsystem (col. 3, line 16) for replenishing the propellant.

14. As to claim 5, Hoskins discloses that the capillary subsystem propellant is semi-molten (col. 7, line 58-60, the propellant turn into semi-molten state before it evaporates as the laser beam ablates to the surface, therefore, the capillary subsystem utilize the surface tension of the semi-molten state during the ablates process) during operation of the thruster and wherein the capillary subsystem utilizes surface tension of the semi-molten propellant.

15. As to claim 8, Hoskins discloses that a propellant housing 31 (fig. 1) for protecting the propellant from environmental factors.

16. As to claim 23, Hoskins discloses that a method of providing thrust propulsion to a spacecraft comprising; pulsing laser energy 702, 704 (fig. 7) onto a propellant 34 (fig. 1) have a self-regenerative surface morphology (fig. 1, the laser is ablated the propellant to generate exhaust plasma, the propellant turn into semi-molten state before it evaporates, as the laser bored

into the surface of the propellant, bored surface is replaced by the propellant in semi-molten state, therefore, the propellant is inherently having self-regenerative surface morphology) to ablate the surface and form ionized plasma (col. 7, line 60-67) and generating an electromagnetic field to collimate trajectory of the exhaust plasma to provide thrust (col. 1, line 37-43).

Claim Rejections - 35 USC § 103

17. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

18. Claims 6 and 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hoskins in view of Knuth (US Patent No. 6,101,808). Hoskins discloses that the voltage applied to capillary ducts of the capillary subsystem generates an electric field, the propellant having a dielectric constant sufficient to sustain the electric field (see fig. 1 and 7) but does not disclose that the thruster comprising propellant gauge sensor and the propellant gauge sensor measures capacitance of the capillary ducts to determine the amount of propellant. However, Knuth teaches the thruster comprising a propellant gauge sensor 78 (fig. 4) for determining an amount of remaining propellant and the propellant gauge sensor 78 (fig. 4, the sensor can be used to measure the capacitance) measures capacitance of the capillary ducts to determine the amount. Therefore, it would have been obvious to one of ordinary skill in the art at the time invention was made to modify Hoskins's invention to include a propellant gauge sensor, wherein the propellant gauge sensor measures capacitance of the capillary ducts to determine the amount of propellant, as suggested and taught by Knuth, for the purpose of providing a suitable means to monitor

propellant during use.

19. Claims 9 and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hoskins in view of Byers (US Patent No. 6,216,445). Hoskins discloses the essential feature of the claimed invention except that the thruster comprising one or more propellant heaters for heating the propellant such that it is in a molten state that enables inflow into capillary feed slots, to feed and replenishment the propellant a point of ablation and one or more propellant heaters for heating a surface of the propellant such that the surface is in a semi-molten state, wherein propellant surface tension continually reforms the surface. However, Byers teaches thruster comprising one or more propellant heaters 52 (fig. 2a) for heating the propellant such that it is in a molten state that enables inflow into capillary feed slots, to feed and replenishment the propellant a point of ablation (as the propellant is heated whether by the heater or laser beam, it is inherently turn into semi-molten state before it evaporates in order to produce thrust, therefore, it enables the propellant to flow through the feeding duct or slot) and one or more propellant heaters 52 (fig. 2a) for heating a surface of the propellant such that the surface is in a semi-molten state, wherein propellant surface tension continually reforms the surface. Therefore, it would have been obvious to one of ordinary skill in the art at the time invention was made to modify Hoskins's invention to include the thruster comprising one or more propellant heaters for heating the propellant such that it is in a molten state that enables inflow into capillary feed slots, to feed and replenishment the propellant a point of ablation and one or more propellant heaters for heating a surface of the propellant such that the surface is in a semi-molten state, wherein propellant surface tension continually reforms the surface, as suggested and taught by Byers, for the purpose of producing a high pressure vapor thereby would increase thrust (see abstract).

20. Claims 11 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hoskins in view of Byers further in view of Jackson (US Patent No. 5,819,536). Hoskins's modify invention discloses the essential feature of the claimed except the thruster comprising one or more propellant temperature sensors for monitoring temperature of the propellant to ensure that the propellant is not overheated but is maintained in a molten state in the propellant container. However, Jackson teaches the thruster comprising one or more propellant temperature sensors (col. 4, line 21) for monitoring temperature of the propellant to ensure that the propellant is not overheated but is maintained in a molten state in the propellant container. Therefore, it would have been obvious to one of ordinary skill in the art at the time invention was made to modify Hoskins's invention to include the thruster comprising one or more propellant temperature sensors for monitoring temperature of the propellant to ensure that the propellant is not overheated but is maintained in a molten state in the propellant container, as suggested and taught by Jackson, for the purpose monitoring temperature of the propellant.

21. Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hoskins in view of Jackson. Hoskins discloses the essential feature of the claimed invention except that the thruster comprising one or more propellant temperature sensors for monitoring temperature of the propellant, the thruster utilizing the temperature sensors to maintain the propellant in a semi-molten state at a surface of the propellant. However, Jackson teaches the thruster comprising one or more propellant temperature sensors (col. 4, line 21) for monitoring temperature of the propellant, the thruster utilizing the temperature sensors to maintain the propellant in a semi-molten state at a surface of the propellant. Therefore, it would have been obvious to one of ordinary skill in the art at the time invention was made to modify Hoskins's invention to include

the thruster comprising one or more propellant temperature sensors for monitoring temperature of the propellant, the thruster utilizing the temperature sensors to maintain the propellant in a semi-molten state at a surface of the propellant, as suggested and taught by Jackson, for the purpose monitoring temperature of the propellant.

22. Claims 13 and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hoskins in view of Schubert (US Patent No. 3,595,020). Hoskins discloses the essential feature of the claimed invention except that the propellant comprising a wax based material and is Paraffin. However, Schubert discloses the propellant comprising a wax based material (col. 1, line 64) and is Paraffin (col. 1, line 63). Therefore, it would have been obvious to one of ordinary skill in the art at the time invention was made to modify Hoskins's invention to include the propellant comprising a wax based material and is Paraffin, as suggested and taught by Schubert, for the purpose of producing high energy burnable gas (col. 1, line 58-59).

23. Claims 15-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hoskins in view of Warboys (US Patent No. 6,449,941).

24. As to claim 15, Hoskins discloses that a hybrid electric-laser propulsion thruster comprising; a propellant 30, (fig. 1, the laser is ablated the propellant to generate exhaust plasma, the propellant turn into semi-molten state before it evaporates, as the laser bored into the surface of the propellant, bored surface is replaced by the propellant in semi-molten state, therefore, the propellant is inherently having self-regenerative surface morphology) having self-regenerative surface morphology, a laser 704 (fig. 7) for ablating the propellant to create an ionized exhaust plasma (col. 7, line 64-67) that is non-interfering with a trajectory path of expelled ions and an electromagnetic field generator 722A, 722B (fig. 7) for generating an electromagnetic field that

defines a thrust vector for the exhaust plasma (col. 7, line 60-67). Hoskins does not disclose that a plurality of modular HELP thrusters ganged together to provide cooperative thrust. However, Warboys teaches a plurality of modular HELP thrusters 502 (fig. 5A) ganged together to provide cooperative thrust. Therefore, it would have been obvious to one of ordinary skill in the art at the time invention was made to modify Hoskins's invention to include a plurality of modular HELP thrusters ganged together to provide cooperative thrust, as suggested and taught by Warboys, for the purpose of providing more thrust.

25. As to claim 16-19, Hoskins discloses that each unit comprising of capillary feed means (col. 3, line 16) for replenishing the propellant, but does not disclose that the multi-HELP thruster comprising a controller for implementing control algorithms for controlling one or more of the HELP thrusters to meet commanded performance, each of the thrusters being modular in construction such that any one HELP thruster is replaceable with multi-HELP thruster and the multi-HELP thruster interlocking fixtures to connect the HELP thrusters together. However, Warboys teaches the multi-HELP thruster comprising a controller for implementing control algorithms for controlling one or more of the HELP thrusters (col. 6, line 46-51) to meet commanded performance, each of the thrusters being modular in construction such that any one HELP thruster is replaceable with multi-HELP thruster (col. 7, line 2-6) and the multi-HELP thruster interlocking 502 (fig. 5A) fixtures to connect the HELP thrusters together. Therefore, it would have been obvious to one of ordinary skill in the art at the time invention was made to modify Hoskins's invention to include the multi-HELP thruster comprising a controller for implementing control algorithms for controlling one or more of the HELP thrusters to meet commanded performance, each of the thrusters being modular in construction such that any one

HELP thruster is replaceable with multi-HELP thruster and the multi-HELP thruster interlocking fixtures to connect the HELP thrusters together, as suggested and taught by Warboys, for the purpose of controlling multiple thrusters and operating more efficiency compare to single thruster because the system can still operate in the event of an individual failure of one thruster (col. 7, line 1-6).

26. Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hoskins in view of Warboys further in view of Beck (US Patent No. 6,530,213). Hoskins's modify invention discloses the essential feature of the claimed invention except the multi-HELP thruster comprising fiber optic pigtails and electrical bus for 'plug-and-play' supply of optical and power signals for the multi-HELP thruster. However, Beck teaches the thruster comprising fiber optic 44 (fig. 3) pigtails and electrical bus 53 (fig. 3) for 'plug-and-play' supply of optical and power signals. Therefore, it would have been obvious to one of ordinary skill in the art at the time invention was made to modify Hoskins's invention to include multi-HELP thruster comprising fiber optic pigtails and electrical bus for 'plug-and-play' supply of optical and power signals for the multi-HELP thruster, as suggested and taught by Beck, for the purpose of sending and receiving electrical signal (col. 8, line 43-46).

27. Claims 21 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hoskins in view of Warboys further in view of Schubert. Hoskins's modify invention discloses the essential feature of the claimed invention except that the propellant comprising a wax based material and is Paraffin. However, Schubert discloses the propellant comprising a wax based material (col. 1, line 64) and is Paraffin (col. 1, line 63). Therefore, it would have been obvious to one of ordinary skill in the art at the time invention was made to modify Hoskins's invention

to include the propellant comprising a wax based material and is Paraffin, as suggested and taught by Schubert, for the purpose of producing high energy burnable gas (col. 1, line 58-59).

28. Claims 24-28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hoskins in view of Schubert.

29. As to claim 24-27, Hoskins discloses that a method of providing thrust propulsion to a spacecraft comprising dynamically controlling (col. 1, line 32-35) the thrust during operation of the spacecraft and setting an operating regime to ablation dominated (ablation dominated can be controlled based on laser intensity which is well known in the art, therefore, an operating regime is controlled as the laser ablates the propellant surface). Hoskins does not disclose that the propellant comprising a wax based material and is Paraffin. However, Schubert discloses the propellant comprising a wax based material (col. 1, line 64) and is Paraffin (col. 1, line 63). Therefore, it would have been obvious to one of ordinary skill in the art at the time invention was made to modify Hoskins's invention to include the propellant comprising a wax based material and is Paraffin, as suggested and taught by Schubert, for the purpose of producing high energy burnable gas (col. 1, line 58-59).

30. As to claim 28, Hoskins discloses that a method of providing thrust propulsion to a spacecraft comprising electing thruster operation, thruster components and configuration, and propellant as a function of spacecraft mission (col. 1, line 24-36, the thruster inherently provides thrust to spacecraft while the propellant, configuration and operation can be modified according to spacecraft mission by the operator)

31. Claim 29 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hoskins in view of Warboys. Hoskins discloses a method of providing thrust propulsion to a spacecraft

comprising; pulsing a laser onto a propellant 30, (fig. 1 and fig. 7, the laser is ablated the propellant to generate exhaust plasma, the propellant turn into semi-molten state before it evaporates, as the laser bored into the surface of the propellant, bored surface is replaced by the propellant in semi-molten state, therefore, the propellant is inherently having self-regenerative surface morphology) having self-regenerative surface morphology, and form ionized exhaust plasma (col. 7, line 59-67) and generating an electromagnetic field to collimate trajectory of the exhaust plasma to provide (col. 7, line 60-67). Hoskins does not disclose that a method of providing thrust propulsion to a spacecraft comprising, pulsing a plurality of lasers onto a plurality of propellants. However, Warboys teaches a plurality of modular HELP thrusters 502 (fig. 5A) ganged together to provide cooperative thrust. Therefore, it would have been obvious to one of ordinary skill in the art at the time invention was made to modify Hoskins's invention to include a method of providing thrust propulsion to a spacecraft comprising, pulsing a plurality of lasers onto a plurality of propellants, as suggested and taught by Warboys, for the purpose of providing more thrust to the spacecraft.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to PHUTTHIWAT WONGWIAN whose telephone number is 571-270-5426. The examiner can normally be reached on Monday - Thursday, 7:30am - 5:00pm EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, QUANG D. THANH can be reached on 571-272-4982. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Art Unit: 4177

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/P. W./
Examiner, Art Unit 4177

/Quang D. Thanh/
Supervisory Patent Examiner,
Art Unit 4177